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ABSTRACT

Research in the development of musical perception is described. It is crucial to students' experience that they learn to bring to the surface those "invisible" ideas inherent in music development such as clapping a rhythm or singing a tune. In this way they learn to bridge the gap between intuitive knowledge and the representation of this knowledge which can lead to greater musical appreciation. One such exercise requires students to arrange a given set of musical blocks into a whole tune. This immediately involves students in active listening, searching for coherence, and thinking about a melody as interrelated parts of a particular whole. A second exercise requires varying melodic rhythms to be represented in their relation to the underlying pulse of the tune. A representation is sufficiently powerful when students can intuit musical events and relations in a way which they can generalize and transfer to other musical situations. Such representations give the listener a means for actually perceiving aspects of a composition that were previously inaccessible. (Author/DE)

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THE LUXURY OF NECESSITY

by

Jeanne Bamberger

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Jeanne Bamberger May 13, 1974

THE LUXURY OF NECESSITY

When I was asked to speak about music and general education, I was reminded of the time some five or six years ago when we were first putting together our book, "The Art of Listening". At the time I had the notion that the music consumer (in contrast to the music producer) needed something different from the watered-down music history or music theory course that was his usual fare. The book was my solution then. But since then the search has led me to inquiries of a far more fundamental nature than I ever anticipated at that time. I found that the luxury of asking questions like the following was no less than a necessity:

> What distinguishes a "musical listener from an "unmusical" listener?
> How does a non-reading listener think about a melody; how does he represent it to himself?
> How do modes of representation (intuitive in contrast to formal) influence perception--i.e., influence the listener's priorities of focus, his access to the various features and relations of a composition?
> What, indeed, is the difference between simple and complex works?
> How do all of these things influence what is casually termed, "taste"?

In short I found that I needed to discover just how musical perception develops, just how we learn to 'make sense" of a piece of music.

The questions had eventual implications for the education of music consumers but first they necessarily carried me into uncharted areas where the boundaries between professional education and general education blurred, indeed, into areas where the boundaries between domains

of knowledge seem to disappear. My quest propelled me into a community of mathamaticians, psychologists, poets and philosophers, children, college students and distinguished composers all engaged together in probing their various ways of "seeing" the world around them. Thinking again, now, about the practical question of educating consumers, the ambience I have found within this community seems to me to offer a kind of paradigm for what that much abused word, general education, might be.

The paradigm is admittedly luxurious, but like my own inquiries it seems to me a luxury of necessity if we seriously want to influence the level of engagement of our audiences, even the place, the value of music in our society. Put most simply, the paradigm suggests the necessity to consider what is possible not just what is practical. It means probing assumptions, facing ambiguities, asking hard questions--all things we DO as musicians but too frequently leave outside the door when we enter the classroom to talk ABOUT music, when we design course requirements or test whether these requirements have been met.

But let me be more specific since I don't intend this as merely a polemical vision. My specifics are drawn from the work we are doing at M.I.T. in the Division for Study and Research in Education. Our students range from elementary school children to undergraduates and graduate students--some music majors, others from such widely varying areas as psychology, computer science, math or education. Together we have built the nucleus

of an environment for research in the development of musical perception and learning as well as an actual laboratory where students are experimenting with the materials, media and new curricula that we are designing.

Crucial to the students experience is that in this lab they learn to bring to the surface those "invisible" ideas inherent in what they can DO -- like clapping a rhythm or singing a tune. In this way they learn to bridge the gap between intuitive knowledge and powerful representations of this knowledge which will lead them to new knowledge.

> For example, it is our hunch that lack of success in school is often related to the gap existing between a student's personal, often unarticulated, representation of particular knowledge (his imagry or picturing of phenomena) and the traditional more formal representations taught in school. The problem lies in differences between just what features of the phenomena are captured by the various representations; for example, how the phenomena is grouped and the level of articulating a "thing" -- just what constitutes a significant structural element. Our initial research demonstrates, for example, that those who "play by ear" actually focus on different features and relations than those who have learned to read music. Note that it is not that one representation is <u>better</u> than another, but rather that each serves different useful <u>functions</u> for its user.

Through the interactive computer facilities of our Laboratory, together with various peripheral devices (including a "music box") students can, in fact, explore their own intuitive knowledge. The paradigm of procedure is this:

> "Make a description of what you would <u>like</u> to happen, try it out and see what <u>does</u> happen".

The result is often surprising but from these surprises grow the most productive insights. Indeed, through these insights we can see our students cracking the barriers of seemingly unmanageable problems in learning or listening. "I don't know how to do that" can become the beginning of a child's work instead of the moment to turn aside and turn off.

While our facilities and curriculum are still very much in a fluid state of development we have tried to outline some immediate goals. For example, the following became initial criteria for our first projects:

They should be

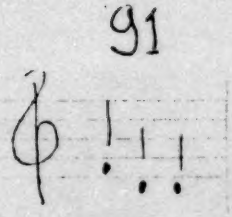
1) Easy to do, mechanically.
2) Provide children (or beginning adults) with an entry into music making that is close to their intuitive level of musical engagement.
3) Open ended, leading to significant new understanding as well as to new questions which can be explored through the students' own design of new projects.
4) Reveal generalizable concepts and powerful procedures for both making and analyzing just how music "makes sense".
5) Develop musical "skills" and more important, develop musically intelligent listeners and players.

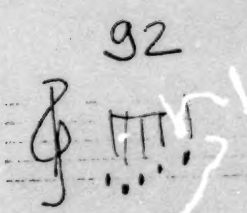
Our very first project was a game that came to be called "Tune Blocks". To capture the experience of a student playing this game, put yourself in his place. Seated before a computer terminal, you type, let's say, G1. Instantly the electronic music box performs

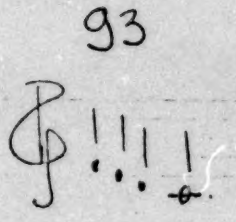
for you a brief, three-note motive. In any one example of the game you may be using between three and ten such motives. We call them "tune blocks" -- like building blocks of various shapes. The game is to arrange a given set of blocks so that they make a whole tune -- either one you have already heard, or a whole tune that you like, that makes sense to you. In this latter, more interesting version of the game, notice that while the blocks are taken from an existing, but unfamiliar tune, you are not trying to get a "right" answer, but rather to invent your own reasonable tune within the limitations of the set of blocks. You can, of course, play the blocks as often as you want, individually or in any arrangement of successive blocks.

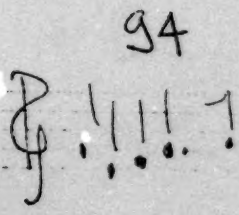
While the game seems obvious enough we were astounded to discover the varieties of strategies and levels of engagement with which the students became involved. There seemed to be as many styles of playing the game as there were players. In one instance eight college students, all using the same set of blocks, invented eight different melodies.*

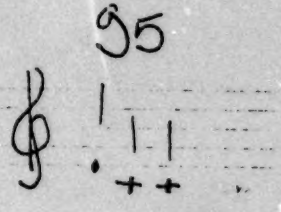
* For a thorough discussion of this experiment, see "WHAT's IN A TUNE" (in press as part of "THE ARTS AND COGNITION")



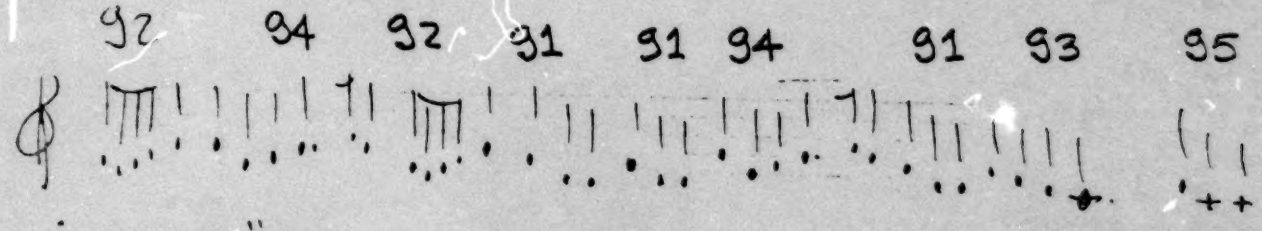








MARK's MELODY



JORGE's MELODY

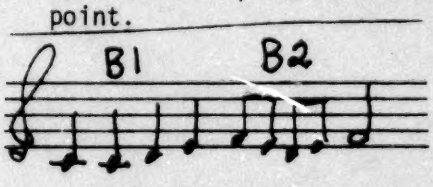
ORIGINAL FRENCH FOLK SONG

Each student's melody was met with astonishment and often even distaste by the rest of the students. Indeed, in order to understand another student's tune, the other members of the class had to "restructure" their thinking, "adjust" their perception, of the shared material. Jorge's melody was probably the biggest surprise; interestingly, Jorge was from Peru, his musical background included almost exclusively the folk melodies of his own country. Listening to some of these Peruvian songs, it was clear that they offered a different model of a sensible tune compared with our own folk songs. In fact, Jorge's "composed" tune was much closer in structure to the Peruvian songs than to our own common tunes. When he finally heard the original folk song from which the blocks were taken, he said, "Wow! I never heard a tune like that."

The game revealed other interesting aspects of learning and perception, too. Our observations of young children (7 to 12) demonstrated that even the youngest of them had no difficulty managing the gadgets; indeed, they were immediately involved in active listening, searching for coherence, thinking about a melody as interrelated parts which together make up a particular whole, and nearly all of them began to sing, quite in tune, as they worked at the game. "Elements" of a tune seemed to be instantly accessible to them on an intuitive level of engagement. Because an "element" was not presented as a discrete pitch and its duration, i.e., not limited to a note, the student's engagement and discrimination was directed initially to the general "shape" of a motive.

For example:

Students might observe that one block "went down" or that another "went faster". But as they played with various arrangements of the blocks, embedding them in new contexts, the students gradually became aware of new and different features of the individual blocks. One student commented that a particular block "seemed like a plateau"; later on he discovered that the block went down in pitch and then returned to its starting point.



B2 "a plateau"

Evidently, in its initial context, he had heard only its boundaries; later he discovered its inner movement and with this a different picture of parts and wholes - a different representation of its features and relations. But it is important to remember that the student's initial representation ("a plateau") was also valid: in fact, Block 2 is static; it functions as an embellishment of a single focal pitch - it is indeed a structural

> plateau.* What is important, here, is the relation between his two representations - detail in relation to larger structural function. Indeed, the whole notion of what constitutes a significant "element" became one of paramount importance influencing the students' perception as well as the eventual structure and affect of each student's completed tune.

The project was clearly open-ended; in fact, for some adult students, it was too much so. For example, players would frequently comment that some block "sounds like an ending". For the children and for more product-oriented adults, this more global observation concerning the potential function of an entire block in the larger structure was simply useful to their task -- they put the block at the end and worked backwards. For some it became a source of probing questions: "Why does it sound like an ending, what features contribute to my intuitive sense of its completion, why does only this block work as a close?" For the children these were questions that developed later; for some adults they were so urgent that they needed to grapple with them before going on to build a tune. Anyone of these questions would be difficult for beginning students to come to grips with because they plunge him immediately into the intricacies of tonality as syntax, as a system of interrelated functions involving both pitch and time. But they are possible questions that

* Interestingly, the analytic process of our student is just opposite of the traditional one. That is, traditionally one starts with notes on a printed page, or perhaps notes ("places") on an instrument. Analysis often consists in abstracting functions which a group of notes together generate. Thus, one describes some notes as fundamental structural pitches and others as embellishments of this "large line". Intuitive perception seems in some instances, to start with the "large line" and work down into the details, the exact notes, which generate it.

both children and adults can find answers to by making things happen and watching (or listening to) the results.

A second set of projects involved students more specifically with the "contents" of tune blocks. How could students capture the features of a tune block in a description that would be close to their spontaneous representations, but at the same time give them access to significant structural relations? Rhythm seemed the most natural place to start. All the children and most of the college students could clap along with the "rhythm" of a melody (i.e., its set of varied durations) or keep time with the beat generated by that rhythm. (And some could even do both at once using hands and feet). But to capture the rhythm of a melody in a meaningful description, it was essential to show the way these two layers of motion intersect. That is, the varied durations of the melody had to be represented in their relation to the underlying pulse. It was hard to "see" this two dimensional schema.

We had to find a good way to picture what the student could DO spontaneously - a picture that would happen simultaneously with their actions and one that was moving, not static. We devised an electronic "drum" which caused the computer to picture on a TV screen what he played or the drum. As you play, the picture comes up on the screen, simultaneously with your performance. [The picture that the computer "draws" is very close to the representations that naive students (adults or children) make spontaneously]. Once you've played your piece and left

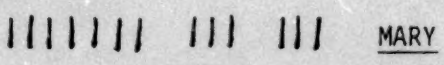
your marks, you can play it back, hear it and see it appearing across the screen again just as when you played it the first time. And the computer can also generate a pulse for you. You can hear the pulse before you start playing, then as you listen to the pulse and play the rhythm of your piece, the pulse leaves a trace along with the trace of your performance.

Or if you prefer you can "hide" the beat, just hear it, play your piece letting the pulse generator "keep time" for you like a metronome and then try to picture for yourself where the beat coincides with your piece.* To make this easier, you can freeze the completed picture of your piece on the screen, think about it, and then make the beat appear to check your guess. As we shall see, this is a crucial step which can sometimes dramatically transform your intuitive representation of the piece.

The remarkable thing about the picture is that it constitutes a very general description of the fundamental coherence-making relations inherent in the rhythmic structure of a figure. In particular, the description captures not only the exact relation of "beat" to "piece",

* Of course, this is also a good excercise in following a beat.

but it also reveals the multi-leveled grouping structure inherent in what we respond to as coherent configurations. Putting it more simply, the description allows its user to get hold of just what he hears as a "thing", as an element. But, as in the tune blocks his initial perception of an element may change. Let me illustrate:



Let's say that I first grab as elements the basic "chunks" or motives which the rhythm of Mary generates. It's instantly clear to both my "ear" and my "eye" that there are three such chunks--one longer and two shorter ones. Each chunk is defined or delimited by a bigger space between hits which means, of course, a bigger space-of-time between hits. I have to remember, though, that while I hear a "stop", those spaces are not empty--time or motion continues on right through those non-null spaces. But the last hit in each chunk does seem to act like a border or limit to the hits preceding it. As I watch the picture moving across the screen, this last hit of a motivic group seems like a goal, an arrival. I may even notice that the two shorter chunks seem like fragments of the longer one.

Now how can I grab my spontaneous sense of fragmentation? How are these shorter chunks related to the longer chunk? I would like to get at the actual durations of each "hit" within these chunks. I need to think about a smaller, maybe different element.

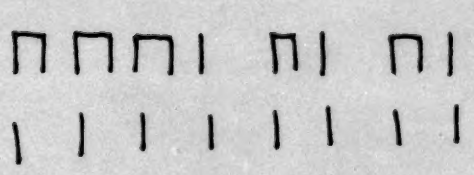
Since the underlying pulse is always the same, I can make use of it as an element to describe the exact durations of the figure. In fact, taking the beat as an element will allow me to translate the figure into standard music notation:

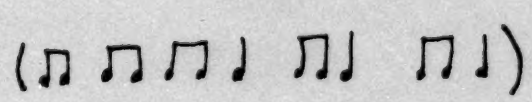
1) Consider the marks left by the pulse as describing the fundamental time unit.

2) Consider that the duration of this time unit defines a "group".

3) Then all hits in the figure that occupy this time-space are members of this group.

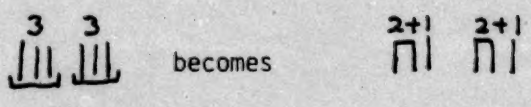
4) To represent the members of a group, draw a cross beam to connect all the members together.





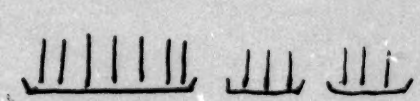
Like magic the Time Machine picture turns into familiar music notation. But please notice, the interaction between the two dimensions of the original space-time analogue (beat and piece) capture all the fundamental relations necessary for this transformation. Indeed, the rules for transformation are simply a simulation of the people-process used in notating a heard or imagined rhythm, as well as the process used in reading or decoding it. It appears we have captured, here, a general theory inherent in standard rhythm notation. Indeed, the theory generalizes to include the meaning of all varieties of note symbols. With it the students no longer need to wait to "get" 16th notes or even "dotted notes".

But something more important has happened in the process of finding this new representation: Initially I focused on the motivic chunks generated by the figure. With this focus I found three groups--the last two, I heard as fragments of the first. Focusing now on the beat as group, I see a different structure which in turn influences my "perception". I find that my two smaller chunks, the fragments, are broken apart. The three contiguous hits which clung together to form a single "thing" have become, now, two "things"--2 hits plus 1 hit:

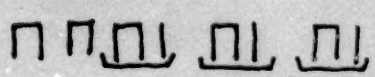


Each description captures different but significant features and relations of the same figure.

As I consider these two descriptions together, I find the answer to my previous question, namely, what musical means generate my sense of fragmentation: Using the beat to define a group, the undifferentiated larger chunk is articulated in a new way--I have a different view of the structure, a new representation. With this new view I discover that the 2 + 1 grouping of the shorter chunk is already present as the "tail" of the larger chunk:



CHUNK AS GROUP



BEAT AS GROUP

Just as with the tune blocks, a new representation provides access to new features which significantly contribute to my perception. Superimposing the two representations, the two kinds of grouping structure, I create a higher level representation. Indeed a crucial characteristic of a higher level representation, is that it includes an aggregate of relations. In this case, the higher level representation suggests an aggregate of possible groupings each of which is right and none of which excludes the others.

It is thus the student's growing ability to shift his focus to, or even meld these various representations of grouping which expands his perception giving him access to compositional means that go well beyond

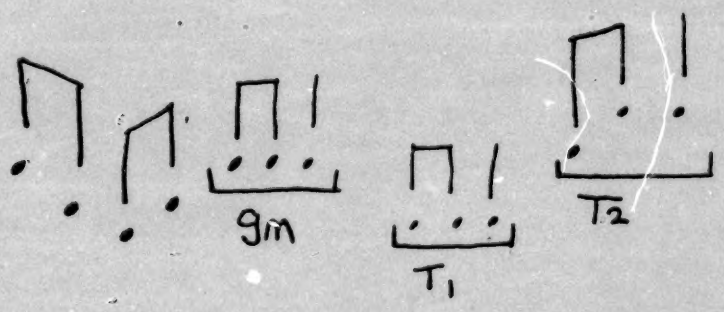
the limitations of simple tunes. Through his more powerful representation of a simple tune, then, the student is led to aspects of music which common tunes share with more extended and complex compositions.

Let me give another example of how a powerful representation of a common tune can lead to an understanding of more sophisticated pieces.

Schoenberg speaks of the germinal "shapes" from which a work evolves. Through the variation or transformation performed on such germinal shapes, a work develops its particular, unique structure and coherence.

> Even the writing of simple phrases involves the invention and use of motives, though perhaps unconciously . . . The motive generally appears in a characteristic and impressive manner at the beginning of a piece . . . Inasmuch as almost every figure within a piece reveals some relationship to it, the basic motive is often considered the "germ" of the idea . . . However, everything depends upon its use . . . everything depends on its treatment and development.

The "simple phrase" from Mary Had . . . reveals in primitive form an example of just such variation:



> If I consider the tail of the first long chunk as a germinal motive (GM), then T1 is a transformation of it: Not only is T1 a fragment of the longer initial chunk, but also it makes use of a new set of pitches. But T2 is a further transformation: GM and T1 are invariant in their set of durations and in their pitch-shape--i.e., in each, a single pitch is repeated. But in T2 pitch-shape is no longer invariant; only the set of durations remains the same. Within the miniscule world of this tune, I catch a glimpse of what we might call order or degree of transformation. Indeed, the sense of tiny climax generated at the end of this section of Mary Had . . . is partly due to this increase in degree of transformation. Along with that goes the important fact that the tune moves beyond its previous, very limited range, achieving a high point. But this, too, could be thought of, or represented, as a structural transformation.

Such a representation of Mary does capture the powerful notion of motivic transformation. But clearly there is a qualitative difference between motivic transformation as it functions in Mary and motivic transformation as it functions in a work by Schoenberg. How, then, can the foregoing representation of Mary lead the student to a better understanding of, an increased perception of, works by Schoenberg or, indeed, Haydn or Beethoven? Let me answer with a digression:

Earlier in my remarks I suggested that it was crucial to the student's learning to be able to bring to the surface those "invisible" ideas inherent in what he could do spontaneously with simple tunes--clap, sing, make sense of them. We can now refer to these "invisible" ideas as a person's internalized representation of the tune; that is,

his way of sorting out, relating and interrelating its various features, his way of thinking the tune. Through the foregoing examples of exploratory projects (tune blocks, time machine, motivic analysis) I have tried to illustrate the nature of such representations and then to suggest just how these kinds of activities can lead to new and more powerful internalized representations. The crux of the matter lies just there: Through this kind of interactive study of simple tunes, students can "grab" their intuitive representations of musical structures and then go on to develop more powerful representations of the "same" structures. A representation is sufficiently powerful if it captures events and relations in a way which will generalize to and explicate varied instances of it in both simple and complex musical situations.

As an example of relations I would like students to capture, even in simple tunes, consider the following:

1) Parallel but interrelated grouping structures. (see p.15)

2) Detail in relation "large line". (see p. 8)

3) Transformation as a process of varying some features of a germinal shape while leaving others alone. (see p.16)

4) The possibility for exploring just which features under just what conditions are "crucial" to significant transformations in meaning and structural function. (see p.19-22)

5) The proliferation of these notions of transformation into other parameters such as texture, harmony, instrumentation and the like.

6) Consideration of complexity as related to the level of structure and the rate at which transformation occurs as well as the particular parameters involved in transformation.

7) Consideration of all of the above as they function to define and distinguish diverse musical styles.

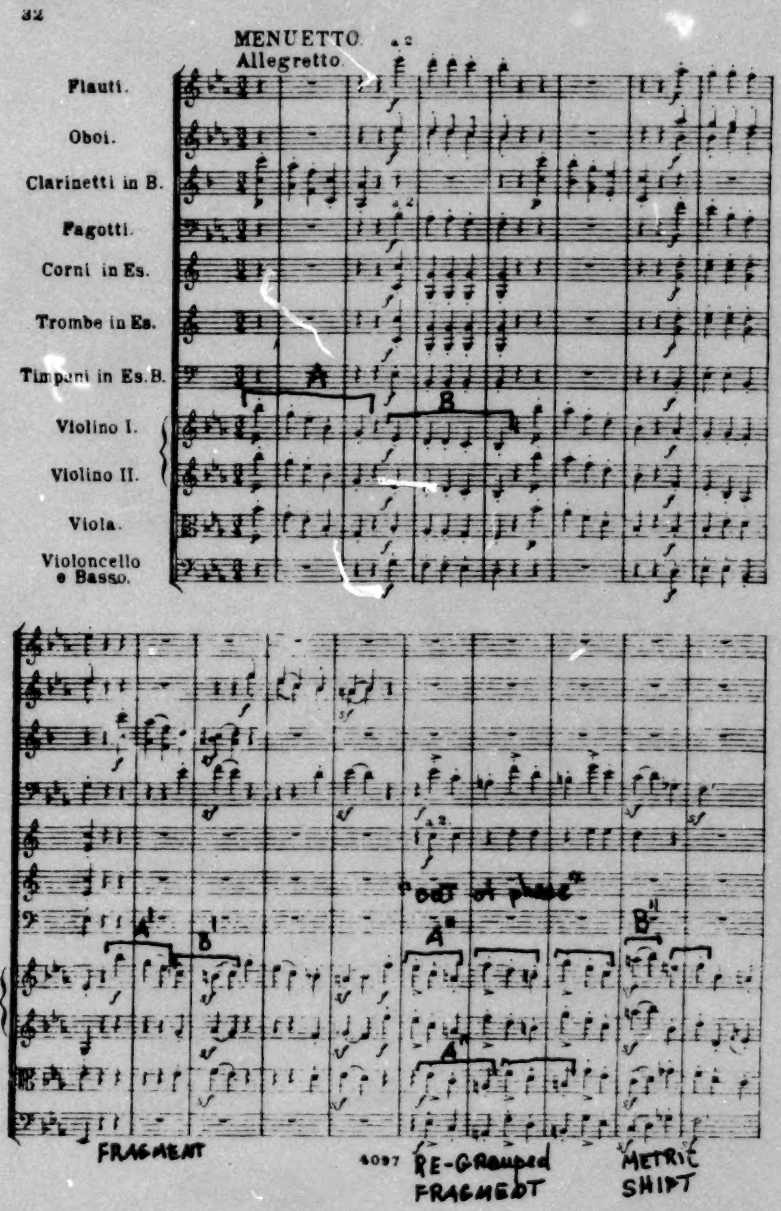
8) The relevance of notions like invariance, analog, transformation, hierarchy, and interactive grouping structures across domains of knowledge.

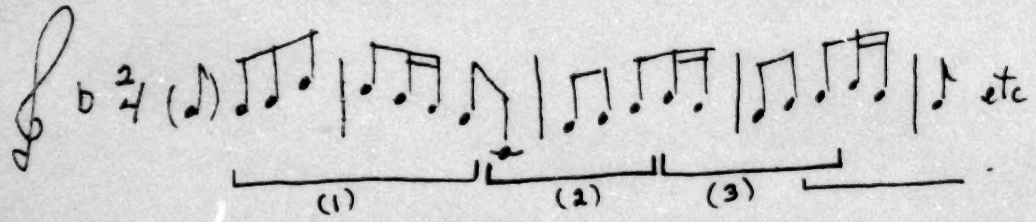
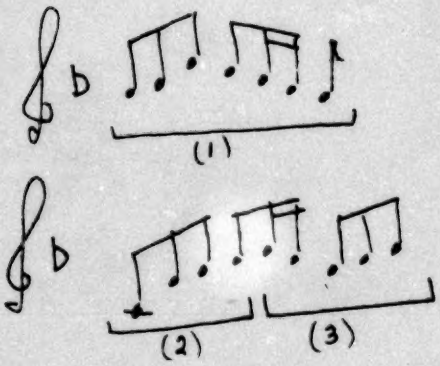
The power in such representations rests in giving the listener means for actually perceiving aspects of a composition that for him were previously inaccessible, even not there! Through this expanded awareness the listener's response changes - his feelings, his sense of value, his "appreciation". Thus, even those students who can't play an instrument, the potential audiences for those who do, find in this environment a rich arena for exploring the magic of musical invention.

But let me emphasize that the activities in our lab are not, even for a day, limited to computer-related projects nor to banal tunes. All of this really comes alive when we consider a work by a great composer. Let me illustrate:

> Recently in a class of college students we listened carefully to the Minuet from the Haydn Symphony 99. The students had been working for several weeks with motivic transformation, manipulation of pitch-time relations, fragmentation, re-grouping of motivic "chunks" and the like. As they listened, now, to just the first part of the movement, they heard what they had never heard before. What had been "just another classical minuet", became a "dramatic work". They heard, for example, how the movement evolves out of its initial motives

in a process of continuous transformation. Reinforced by instrumentation and texture, the rate and degree of transformation increases (more things change, faster) to generate the climax of this first section. At the peak of intensity the opening motive, fragmented, rising sequentially and shifting in meter and tonal center, is heard out of phase against intself!



In another example, we spent several hours one day pondering the principal theme from the first movement of Beethoven's 6th Symphony. The students felt that there was something wonderfully strange about it. They discovered that what appears at first to be a repeated rhythmic figure is, in fact, not "the same" because it shifts its position in the perceived "chunks" of the melody:



Thus, the sixteenth note figure is heard first as the feminine ending of a group, while its next statement functions as an upbeat. In this case, transformation does not involve fragmentation or change in pitch shape or rhythmic shape but rather a change in rhythmic function as a result of its surrounding pitch context. The students had acquired sufficiently powerful tools to grasp "same" and "different" in a non-exclusive, redefinable way: The motive was indeed the "same" but its context made it also "different"!

This, then, is what I mean by gaining access to features and relations which were previously inaccessible. Because the students' mode of representation has changed, they can perceive this melody as somehow extraordinary; and it was they who wanted to find out why!

As Schoenberg says, "-------everything depends upon its use---on its treatment and development." Schoenberg refers here to a germinal motive, but I would add: Everything depends on the listener's internalized representation which must be powerful enough to grasp the composer's particular use of a musical idea, his particular means of transformation, in generating the structural process and affect of a composition. For, indeed, it is what a composer does with a motive that distinguishes a significant composition from a banal one; that is, distinguishes, for instance, transformation as it functions in Mary from the way it functions in these two examples by Haydn and Beethoven.

From the experiences I have described here, I see developing an expanding group of musically intelligent consumers; audiences who will not only be "appreciative" but also demanding. Indeed, such audiences could change the future of musical taste in this country. Hearing more can become liking more and demanding more--be it Haydn and Beethoven or Schoenberg and Billie Holiday. To develop such audiences is, I believe, a luxury of necessity for without such demanding audiences I sometimes fear that music will be, like Shakespeare's fire, "consumed with that which it was nourished by".